in temporary quarters and the permanent building was in progress of construction. No work prescribed in the catalogue has been omitted from the course of any student.

The accompanying plan shows the laboratory as it now stands restored. The portion which was burned included the forge room, machine room and engineering laboratory; also, a three-story front containing offices, recitation rooms and drawing rooms. The outline of the old building has been preserved in the new, but the construction of the front has not yet been undertaken. All laboratory rooms have been entirely finished and equipped. A room has been added for experimental work with natural gas, and the locomotive testing plant has been provided for in a separate building. Not only has the capacity of the structure been increased, but the equipment also in every department has been improved. Time will not permit an enumeration, but the floor plan shows the location of apparatus now in place and in daily use.

It will be seen that while other lines of work have not been neglected, the equipment of the engineering laboratory is especially complete for work in steam engineering. The several engines shown are mounted as separate plants. This arrangement avoids any chance of interference among different groups of students who may be working with different engines at the same time. The Buckeye, Straight Line and Baldwin engines occupy the floor space, which before the fire was taken by the plant now in the annex. The Baldwin consists of a pair of 9½ and 16x18 Vouclain Locomotive Engines fitted up for the purpose of experiment. These engines are supplied with steam from the laboratory boilers and are run under the load of a friction brake.

The locomotive testing plant in the annex laboratory has been much improved. The plant shows Purdue's locomotive, Schenectady, in place, but the arrangement of the plant is such that any locomotive may be received and tested.

The engineering laboratory contains thirty-six steam cylinders aggregating over 1,500 horse power.

Method of Determining Sewage Pollution of Rivers. By Chas. C. Brown, C. E.

[Abstract.]

In 1888 I began work for the State Board of Health of New York on the investigation of the purity of water supplies drawn from rivers, with a detailed inspection of the water-shed of the Croton River from which New York City derives its supply. This was almost entirely an inspection of the actual sources of pollution, though a study was made of the chemical side of the question. The investigations were continued during the following five years on the Hudson and Mohawk rivers, and reports of the work are to be found in the annual reports of the New York State Board of Health since 1888. The inspection of sources of pollution showed what went into the rivers, but the chemical analyses failed to show with sufficient definiteness the effect of this pollution on the water. We then tried the method of determining the numbers of bacteria in the water, and while that was fairly satisfactory when the conditions were simple, we found it to be absolutely necessary that there be no disturbing conditions whatever, so that it was difficult in most cases to find a time when the method could be applied.

We are told by the bacteriologists that the bacteria which are objectionable in drinking water are the bacteria introduced by sewage. We therefore concluded that we should determine the proportion of such bacteria in the water. At this juncture Dr. Theobald Smith, of the Bureau of Animal Industry, Department of Agriculture, at Washington, suggested a method of making this determination, which he was developing, and we applied the method to our study of the rivers with results that are so far quite satisfactory.

The method rests upon the assumptions that *Bacillus coli communis* is a species which is very common in sewage, which does not proliferate under ordinary conditions of running water, and whose numbers may therefore be assumed to bear a fairly definite relation to the amount of sewage pollution. Numerous check observations uphold these assumptions.

The method of determining the numbers of "coli" in a given sample uses the fermentation tube, now frequently called the Smith tube in bacteriological laboratories, as the use of the tube in bacteriology has been developed by Dr. Smith.

The tube, as shown by the pictures, is a bent tube with one end closed and a bulb at the other. It is filled with a clear bouillon of beef with peptone, salt and 2 per cent. of glucose, properly neutralized, or made slightly alkaline. The tube and filling are sterilized by boiling on three successive days, the air driven off into the closed end of the tube, being decanted so as to leave the liquid in the tube sterile, and that in the closed end of the tube without oxygen. The liquid in the bulb is now inoculated with bacteria and the tube placed in an incubator kept at 98° F. for 36 to 48 hours. Classifying the bacteria likely to be found in water as motile and non-motile, and as aerobic and facultative anaerobic, it is readily seen that non-motile and aerobic germs will develop in the bulb only, and will leave the liquid in the tube clear. Motile bacteria that can develop without oxygen will reach the tube and change the character of the liquid. The temperature of 98° at which the tube is kept will prevent the development of nearly all the common water bacteria. Certain bacteria produce gas from media containing glucose in varying amounts, the composition of this gas varying from 0% CO_2 to 100% CO_2.

Bacillus coli communis and two others, much less common but also sewage bacteria, produce 0.4 to 0.7 of a tube full of gas, of which 0.5 to 0.7 is CO_2. All others observed produce amounts of gas and of CO_2, readily distinguishable from those, and are, therefore, easily dropped from consideration.

The process in examining a sample of water is to prepare a sufficient number of tubes of sterile bouillon, and an incubator. The sample of water is distributed among the tubes, an equal amount in each, the amount varying according to the impurity of the water. With a pure water 1 c.c. may be used. With sewage $\frac{1}{200}$ c.c. may be found to be too much. The tubes are placed in the incubator and left at the constant temperature of 98° for thirty-six hours or a little more. They are then taken out and the proportion of gas in each tube is determined. Those promising to contain *Bacillus coli communis* or its companions are treated with an alkali to absorb the CO_2, and the propor ion of CO_2 is thus determined. From the two determinations the number of *Bacillus coli communis* in the sample is derived, and thence the number in a c.c If much more than half the tubes inoculated from a sample contain "coli" the amount of water used in a tube has been too large to produce a result which will compare closely with other determinations. Likewise, if the sample has been diluted with sterilized water before inoculating the tubes, too small a number of tubes with *coli* shows too great dilution to produce results that will check up with others from the same sample.

Many results have been obtained by this method in the last three or four years which seem to give closer determinations of the amount of sewage pollution than any method heretofore used. The method has not yet had wide enough application to demonstrate its value under various conditions, but we feel certain that it has great value in the examination of streams used or proposed as sources of water supply for cities.

I have not time in the limits of this paper to give the results, and give the methods only, as perhaps the more suitable for the purposes of this association at this time.

Psychological Laboratory of Indiana University. By W. L. Bryan.